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EXAMINER	
SIANGCHIN, KEVIN	
ART UNIT	**PAPER NUMBER**
2623	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/835,392	LABELLE, LILIAN	
	Examiner	**Art Unit**	
	Kevin Siangchin	2623	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12 October 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-18 and 20-31* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-3,5-7,9-25,27-29 and 31* is/are rejected.

7)☒ Claim(s) *4, 8, 26, and 30* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *12 October 2004* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

Detailed Action

Drawings

Response to Drawing Corrections

1. New and corrected drawings were received on October 12, 2004. The replacement drawings are unacceptable.

2. As pointed out in the previous Office Action (previous Office Action, page 2, paragraph 2), steps **S609** and **S623** are ambiguous because the Applicant has failed to adequately provide a definition of *function*( ). The Applicant has indicated in Remarks, filed October 12, 2004, that the definition of *function*( ) corresponds to the discussion found on page 23, line 11 of the originally filed Specification. This correspondence, however, is not readily apparent. On page 23, line 11, the following expression can be found:

$$Match(Q,Ds) = \sum_{i=1}^{N} d(h_i^Q, h_i^{Ds}) \qquad (3)$$

This expression is related only to the process shown in Fig. 6b. Technically speaking, the right hand side of equation (3) is a function of the feature vector elements, h_i^Q and h_i^{Ds} $i = 1 \ldots N$, whereas *function*( ) is function of the feature vectors (i.e. *H*(*Q*) and *H*(*Ds*)) themselves. This, however, is a minor detail. The main concern with using the undefined function *function*() is that it gives the impression that *Match*(*Q*,*Ds*), or the result thereof, is an arbitrary function of the feature vectors *H*(*Q*) and *H*(*Ds*). According to the Applicant's disclosure, this is clearly not the case. At the minimum, *function*( ) must indicate the similarity between the vectors *H*(*Q*) and *H*(*Ds*). In and of itself, the function *function*() does not indicate this. Furthermore, the Applicant should notice that *function*() is used in step **S609** of Fig. 6a and in step **S623** of Fig. 6b. This could imply that the functions used to evaluate *Filter*(*Q*,*Ds*) and *Match*(*Q*,*Ds*) in steps **S609** and **S623** are the same. However, according to the Applicant's disclosure, different metrics of similarity are used in steps **S609** and **S623**.

3. These issues can be overcome by replacing *function*() in step **S609** with something that indicates a first similarity (cf. page 21, lines 3-6 of the Specification) – e.g. *first_similarity*( ) – and replacing *function*() in step **S623** with something that indicates and a second similarity (cf. page 22, lines 25-30) – e.g. *second_similarity*( ); or by substituting *function*() with the disclosed mathematical expressions indicating similarity (e.g. equation (3) above).

4. The objections posed in the previous Office Action concerning these issues are, therefore, maintained. All other objections are withdrawn.

5. Corrected drawing sheets are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

Response to Amendments to the Specification

6. The amendments to the Specification, filed October 12, 2004, have been acknowledged. These amendments correspond to acceptable changed made to the drawings.

Claims

Response to Amendments to the Claims

7. The amendments to the Claims, filed October 12, 2004, have been made of record. Claims 1, 2, and 13 have been amended accordingly.

8. As a result of these amendments, the prior rejection of Claim 13 under 35 U.S.C. § 112(2) is withdrawn.

9. Claims 1-3, 5-7, 9-10, 17-24, and 31 remain rejected under 35 U.S.C. § 102(b) as being anticipated by [ChangSmith95] (S. Chang and J.R. Smith, *Extracting Multi-Dimensional Signal Features for Content-Based Visual Query*, SPIE Symposium on Visual Communications and Signal Processing, May 1995).

10. Claims 11, 14, 25, and 27-29 remain rejected under 35 U.S.C. § 103(a) as being an obvious modification of [ChangSmith95], in view of [SmithChang94] (J.R. Smith and S. Chang, *Quad-Tree Segmentation for Texture-Based Image Query*, ACM 2nd International Conference on Multimedia, October 1994).

11. Claim 13 remains rejected under 35 U.S.C. § 103(a) as being an obvious modification of [ChangSmith95], in view of [Folkers00] (A. Folkers, *Pictorial Query Specification and Processing*, Ph.D. Thesis – University of Maryland and Medical University of Lübeck, January 2000).

12. Claims 15-16 remain rejected under 35 U.S.C. § 103(a) as being an obvious modification of [ChangSmith95], in view of [Smith97] (J.R. Smith, *Integrated Spatial and Feature Image Systems: Retrieval, Analysis and Compression*, Ph.D. Thesis – Columbia University, 1997).

13. Claims 4, 8, 26, and 31 contain allowable subject matter, but are dependant on the rejected claims above.

Response to Arguments and Remarks

14. Before proceeding, the Applicant is informed that an explicit statement of rejection was accidentally omitted in the previous Office Action for Claims 10 and 17-24. The Applicant will notice, however, that grounds for the rejections of these Claims were provided. Please refer to paragraphs 16-17 on pages 6-7 of the previous Office Action.

15. A brief summary of the Applicant's invention is presented, followed by an overview of [ChangSmith95]. In the discussion of [ChangSmith95], the Applicant's arguments concerning the "degree of significance of the visual content of at least one block of the image with respect to the overall visual content" will be addressed (pages 17-18 of the Applicant's Remarks, filed October 12, 2004). A brief discussion of [SmithChang94], [Smith97], and [Folkers00] will follow, illustrating the manner in which these references compensate for the deficiencies of [ChangSmith95].

16. *The Applicant's Invention.* The Applicant's invention relates generally to a method of indexing in a content based image querying (CBIR) system. Specifically, according the Applicant's methodology, indices *IDX* are generated for a given *query* image, *Q*, and each of the database images, *D* (cf. Fig. 6a). Each of the indices consist of two elements: the first sub-index, *H*, "characteristic of the visual content of the image", and the second sub-index, *W*, "characteristic of the spatial distribution of the visual content" of the image. The database is parsed in search of database images, *D*, that match the query image, *Q*, by first evaluating the similarity of their respective second sub-indices, *W*(*D*) and *W*(*Q*), with respect to some metric of similarity (e.g. *Filter*(*Q*,*D*) – cf. Fig. 6a). This process produces a set of database images *Ds*. This set is then parsed by evaluating the degree of similarity between the first sub-index *H*(*Q*) of the query image and the first sub-indices *W*(*Ds*) of the previously obtained database images. The *Ds* that satisfy the given criterion of similarity (as defined by, e.g., *Match*(*Q*,*D*) – cf. Fig. 6b) should represent the set of images in the database which most closely match the query image *Q*.

17. According to the Applicant's method, in order to generate an index for a given image *Im*, the image is first decomposed into *N* blocks. This decomposition may either be a regular decomposition or quad-tree decomposition. In accordance with the former, *Im* is partitioned into *N* regularly ordered blocks, all of the same fixed-sized. In quad-tree decomposition, the image is recursively sub-divided into groups of four successively smaller blocks. Although not disclosed by the Applicant, each subsequent phase of the decomposition typically results in blocks exhibiting more homogenous content than the larger blocks of preceding phases. Regardless of the method of decomposition, the Applicant associates a first data item h_i^{Im} with each of the N blocks. h_i^{Im} is indicative of the visual content with the *i*-th block of the image and, in the case of the Applicant's method, is represented as a histogram. Collectively, these first data items are indicative of the visual content of the entire image. This concept is embodied in the

Applicant's first sub-index $H(Im)$, which is an N-dimensional feature vector (tensor) having, as elements, all N block histograms h_i^{Im} – i.e. $H(Im) = \langle h_i^{\mathrm{Im}} \rangle_{i=1\ldots N}$. Each block i of the decomposed image is also associated with a second data item w_i^{Im}, which is indicative of the "visual significance" of the block with respect to the overall visual content of the image[1]. The data items w_i^{Im} indicate the "spatial distribution of the visual content" of the image Im, and can be collectively expressed as the second sub-index $W(Im)$ – i.e. $W(Im) = \langle w_i^{\mathrm{Im}} \rangle_{i=1\ldots N}$. Together, the sub-indices $H(Im)$ and $W(Im)$ form the index $IDX(Im)$ of the image Im.

18. The Applicant proposes several methods for evaluating the similarity between the sub-indices of two images. For the first sub-index H, the Applicant suggests using well-known metrics, such as *histogram intersection*s or the Euclidean distance between histograms. For the second sub-index W, the Applicant suggests the Euclidean distance between the vectors $W(Q)$ and $W(D)$, in cases where the image has been regularly decomposed. If, on the other hand, a quad-tree decomposition is used, the Applicant suggests evaluating similarity on the basis of the isomorphism between the quad-tree of the query image and that of the database images. Although not particularly appealing in terms of computational complexity, this method has been utilized by other authors in CBIR or image comparison applications.

19. In summation, Applicant's method generally involves indexing a database of images – first according to the spatial distribution of visual content throughout an image, as represented by the image's second sub-index W and by the image's quad-tree structure; and, secondly, in accordance with the global visual content of the image, as represented by the first sub-index H. The Prior Art CBIR methods cited below generally involve an evaluation of

[1] Notice that $\|h_i^{\mathrm{Im}}\|^2$ is the energy of the histogram of block i. In keeping with this convention, the total energy associated with the image is $\sum_{\forall i}\|h_i^{\mathrm{Im}}\|^2$. Therefore, the ratio $\|h_i^{\mathrm{Im}}\|^2 / \sum_{\forall i}\|h_i^{\mathrm{Im}}\|^2$ signifies the fraction of the total histogram energy per block i. Given the similarity of this expression with Applicant's equation (1), it can be inferred that w_i^{Im} likewise provides a measure of the (relative) amount of energy deposition per block. [Smith97], for example, shows the relationship between histogram energy (or, more precisely, the fraction of total histogram energy) and visual significance (cf. [Smith97] Fig. 2-4 and Section 4.5.3). Although the claims related to w_i^{Im} were deemed allowable, the Prior Art may provide some motivation for measuring the relative block energy, as w_i^{Im} essentially does.

both the spatial distribution of the visual content within an image and the global visual characteristics associated with the image.

20. *[ChangSmith95].* [ChangSmith95] studies the extraction of multi-dimensional features (e.g. color, texture shape, etc.) from images for the purposes of CBIR. These features can be used for indexing a database of images. [ChangSmith95] is concerned primarily with extracting visual features corresponding to texture, color, and shape (only the aspects of [ChangSmith95] relating to texture and color are discussed here, as they are most pertinent to the Applicant's claimed invention). These aspects of an image essentially define the visual content of an image.

21. Using a spatial quad-tree approach, the image is segmented into sub-regions exhibiting substantially homogenous texture ([ChangSmith95], page P-5). Textures are analyzed in the wavelet domain. Features are derived for each of block of the decomposed image. These include the subband energy(s) σ_i^2 of each block. (cf. [ChangSmith95] Fig. 2)[2]. The texture features of all blocks form a set of features that may be used to index the visual content of the image (cf. [ChangSmith95] page P-5, second to last paragraph).

22. Beginning with the same quad-tree structure employed during the texture analysis, [ChangSmith95] derives the histogram for each terminal node (block) of the quad-tree. In a manner similar to the texture analysis above, the resulting quad-tree decomposition consists of blocks having substantially similar colors. The color histograms, much like the texture features above, collectively form a set of color features which may be used to index the visual content (color) of the image ([ChangSmith95], Section 2.2).

23. The disparate visual features of shape, color, and texture are integrated into a single data structure called an *integrated feature map* ([ChangSmith95], Section 3). The integrated feature map is a quad-tree, whereon the texture, color, and shape features are mapped. This data structure allows an image to be indexed according to a variety of different features (e.g. texture, color, or shape).

24. The integrated feature map (IFM) of [ChangSmith95], therefore, serves as an image index, whereby the visual content of an image is expressed in terms of at least two sets of features – e.g. texture and color. Since each of

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2 Note that the wavelet transform results in a decomposition of the block into several subbands, as depicted in [ChangSmith95] Fig. 2. Therefore, the derived texture features for each block are not limited to a single subband energy.

the constituent feature sets is compared independently during the querying process, each feature set can be treated as a "sub-index" of an image. These indices could arbitrarily be denoted as the "first" sub-index, "second" sub-index, and so on. However, in order to remain consistent with the Applicant's nomenclature (wherein the first sub-index takes into account the visual content of the image, and the second sub-index is "indicative of a degree of significance of the visual content ... with respect to the overall content of the image" and "characteristic of the spatial distribution of the visual content of the image"), the set of color features will be treated as the first sub-index and the set of texture features will be treated as the second sub-index[3].

25. As stated above, the set of color features utilized in [ChangSmith95] consists the color histograms calculated at each terminal node, or leaf, of the quad-tree ([ChangSmith95], Section 2.2, *Quad-Tree Based Color Histogram Indexing*, paragraph 1). This set of features is essentially identical, both in form and purpose, to the Applicant's first sub-index *H*, which is the set of histograms calculated for all blocks of the decomposed image (cf. Applicant's Specification, page 6 last paragraph and page 15, line 24 to page 16, line 4). Like *H*, the set of color histograms describes the overall color content of an image. Note that, as a result of the quad-tree decomposition, the set of histograms are distributed in a spatial ordering. As such, the set of histograms is also indicative of the spatial distribution of visual (color) content.

26. In [ChangSmith95], the set of texture features include the subband energy, or wavelet energy, for each leaf of the quad-tree decomposed image (cf. [ChangSmith95] Fig. 2 and Section 2.1, *Modified Quad-Tree Based Texture Region Segmentation*). [ChangSmith95] shows that distinctive regions of texture (i.e. "visually significant" regions) can be characterized by their respective wavelet energy signatures. These regions are located at the leaves of the quad-tree decomposition of the image (cf. [ChangSmith95] Fig. 4 and Section 2.1, *Modified Quad-Tree Based Texture Region Segmentation*). Again, each of these leaves corresponds to a block of an image exhibiting locally homogeneous texture. Seen in this light, the wavelet energy features represent a "data item of a second type [wavelet energy] indicative of the degree of visually significance [distinctiveness] of the visual content" (i.e. indicative of the texture) "of a block under consideration" (i.e. a leaf of the quad-tree decomposition of the image). Further note that

3 Notice that the first sub-index and the second sub-index correspond, respectively, to the "first information item" and the "second information item" of the Claims. The corresponding terms and will be used interchangeably throughout this document.

the distinctiveness ([ChangSmith95], Section 2.1, paragraph 1) of the block texture can only be differentiated by observing the block with respect to the texture characteristics of entire image (i.e. "with respect to the overall visual content of the image"). Thus, the set of wavelet energies for each block (this set being represented by the quad-tree) collectively represent a "second information item", or second sub-index, "indicative of a degree of significance of visual content of at least one of the plurality of blocks [of the quad-tree decomposition of the image], with respect to the overall content of the image". Again, the spatial distribution of these features (which are indicative of the visual content of the image) throughout the image is given by the spatial quad-tree decomposition discussed above.

27. These wavelet energy signatures also reflect the distribution of energy in the spatial-frequency domain for each block of the decomposition. Therefore, the wavelet energy signature of a block provides insight into the block's spatial-frequency characteristics. For example, blocks having wavelet energy distributed primarily at the low end of the spatial-frequency spectrum correspond to flat, uniform image regions, whereas blocks with energy deposited in higher frequency subbands correspond to textures or edges. In this sense, the wavelet energy signatures of a block again provide a measure of "a degree of significance of visual content ... with respect to the overall content of the image", depending on what is defined to be significant (e.g. flat regions or textured regions). Clearly, in the texture segmentation and extraction phase of [ChangSmith95], texture is of particular significance. From this perspective, it can once again be concluded that the set of all wavelet energy signatures represents a "second information item" in accordance with Claim 1. Further support for this proposition can be found in [SmithChTexture94], [VanDeWouwer97], [ChangKuo93], and [LiangKuo99].

28. *[SmithChang94].* [SmithChang94] provides a more extensive treatment of the spatial quad-tree decomposition discussed above. Furthermore, [SmithChang94] proposes the concept of *hierarchically searching* the image database ([SmithChang94], Section 6.1). Specifically, with hierarchical searching, each dimension of the feature space is searched independently in accordance with the significance of each dimension. As each dimension is searched, the matching set of images is successively reduced until some desired number of retrievals has been obtained. However, in [ChangSmith95], and CBIQ applications in general, the dimensionality of the feature space may be prohibitively large, and would thereby render the hierarchical search of *every* dimension impractical. An obvious alternative to searching the entire feature space of [ChangSmith95] would be to hierarchically search

according to color and texture – essentially treating the set of texture-based features and the set of color-based features as separate dimensions. This observation would have been apparent to one of ordinary skill in the art. The question of which set of features (i.e. which dimension) is most significant was addressed in the previous Office Action (previous Office Action, pages 8-9). To expand on that discussion, notice that the significance of texture-based features over color-based features follows intuitively from one's own perceptual experience. For example, an orange is visually distinguishable from a like-sized orange sphere because of its surface texture. This would be the case even if the color were removed. The dominance of texture-based features over color-based features in human visual perception has been extensively verified in studies of the human visual perception system.

29. [ChangSmith95] also supports this decision of significance being made according to the subjective judgment of a user, as represented by his/her submitted query (cf. [ChangSmith95] page 9, paragraphs 1-2).

30. *[Smith97].* [Smith97] gives a thorough description of the technological and theoretical underpinnings of Columbia University's *VisualSEEk* CBIR system. [ChangSmith95] and [SmithChang94] are also related to this system. In relation to the Claims, [Smith97] teaches a "sum of the distances [– i.e. a *Minkowski distance metric* –] between each of the components of [an] information item associated with [an] example image and the corresponding component of [the same type of] information item associated with [a] stored image under consideration", whereby a similarity between the images is evaluated. [Smith97] also teaches histogram intersection as means for evaluating the similarity between images. Histogram intersection is also taught in [ChangSmith95].

31. *[Folkers00].* [Folkers00] discloses a method for processing pictorial queries into an image database. [Folkers00] evaluates the similarity of a query image and a database image, with respect to three levels of similarity: the *matching similarity level* (*msl*), the *contextual similarity level* (*csl*), and the *spatial similarity level* (*ssl*) (refer to *Algorithm 3.1.1* on page 16 of [Folkers00]; see also Table 2.2 on page 12). [Folkers00] uses graphs to represent the query image and the database images. Notice that the graph representation provides an implicit indication of the spatial distribution of image content within an image (this can be seen from, e.g., Fig. 2.8 on page 14 of [Folkers00] and by taking into account the spatial constraints defined in Table 2.2). Images that are spatially similar to the query image have graph representations that are isomorphic to the graph representation of the query image, while adhering

to the spatial constraints imposed by *ssl*. Thus, [Folkers00] teaches evaluating the spatial similarity of images by determining whether an isomorphism exists between their respective graph representations.

32. As discussed above, [ChangSmith95] stores the set of texture features (i.e. the "second information item") in a spatial quad-tree. It was pointed out earlier that the quad-tree is indicative of the spatial distribution of texture features throughout the image. The previous Office Action contended that, because a quad-tree is a graph (as all trees are) representing an image, one of ordinary skill in the art would realize that the similarity between the query image and database images could be determined by an isomorphic graph matching algorithm, such as [Folkers00]. Clearly, if an isomorphism exists between the quad-trees of two images, then the images can be assumed to have similar spatial distributions of whatever features are associated with the nodes (e.g. textural features). In this way, the isomorphism constraint reinforces the similarity between images by ensuring not only the similarity of texture features, but also a similarity in the spatial distribution of these features.

<u>Rejections Under 35 U.S.C. § 102(b)</u>

33. The following is a quotation of the appropriate paragraphs of 35 U.S.C. § 102 that form the basis for the rejections under this section made in this Office action:

> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

34. Claims 1-3, 5-7, 9-10, 17-24, and 31 are rejected under 35 U.S.C. § 102(b) as being anticipated by [ChangSmith95].

35. *The following is in regard to Claim 1.* [ChangSmith95] disclose method for extracting multi-dimensional features (e.g. color, texture shape, etc.) from images for the purposes ([ChangSmith95], Section 2: *Extracting Low-Level Visual Features – Texture, Color, and Shape*) of querying and indexing a database of images ([ChangSmith95], Section 5, paragraph 1). The method operates on images comprising a plurality of blocks (e.g. blocks of belonging to quad-tree decompositions of the images – cf. [ChangSmith95] Fig. 4) comprises the following steps:

(1.a.) Generating a first information item (i.e. the set of color features or color histograms – [ChangSmith95] Section 2.2: *Quad-Tree Based Color Histogram Indexing*) characteristic of the visual content of the said image. Refer also to the discussion in the previous section of this document.

(1.b.) Generating a second information item (i.e. the set of texture features of the image – [ChangSmith95] Section 2.1: *Texture* and Fig. 2). As illustrated above, the set of texture features is indicative of a degree of visual significance of the visual content of the blocks with respect to the overall visual content of the image, and, thereby, characteristic of the spatial distribution of the visual content of the image in its image plane. Please refer to the discussion of [ChangSmith95] in the previous section of this document.

(1.c.) Associating, with the said image, an index (i.e. an *integrated feature map* – [ChangSmith95] Section 2.3, last paragraph, and Section 3) composed of the said first information item and the said second information item.

36. *The following is in regard to Claim 2.* The method of [ChangSmith95] further comprises:

(2.a.) Dividing the image plane of the said image according to a partitioning comprising the plurality of blocks, the plurality of blocks comprising a predefined number N of blocks. As discussed above, [ChangSmith95] perform a quad-tree decomposition on the image. Although not explicitly disclosed in [ChangSmith95], the decomposition must be subject to some predefined stopping criterion. Stopping according to feature (color or texture) homogeneity alone could result in excessively large tree. Typically, decomposition is stopped after a predefined number of partitions have been obtained or when the tree has grown to a certain depth. Such stopping criteria are inherent to any practical implementation of quad-tree decomposition.

Generating the set of texture features involves:

(2.b.) Extracting from each of the said blocks a data item of a first type (i.e. the histograms of

each block of the decomposed image – [ChangSmith95] Section 2.2: *Quad-Tree Based Color Histogram Indexing*) representing at least one characteristic (i.e. color) of the visual content of the block under consideration. A discussion of these histograms was given above. Please refer to the discussion of [ChangSmith95] in the previous section of this document.

(2.c.) Generating the said first information item as being a vector having N components, each of which is one of the said data items of the first type. Clearly, if a histogram is generated for each of the N blocks, then the set of block histograms consists of N elements. Note that a set is a mathematical abstraction and is typically represented, in practical computational systems, as a vector. Therefore, the set of N block histograms is, for all intents a purposes, a vector of N block histograms.

37. *The following is in regard to Claims 3, 5-7, 9-10, 17-24, and 31.* The rejections of Claims 3, 5-7, 9-10, 17-24, and 31 set forth in the previous Office Action are incorporated, herein, by reference. For the sake of brevity, the details of these rejections are omitted. Please refer to the appropriate sections of the previous Office Action, as well as the discussion of [ChangSmith95] above.

<u>Rejections Under 35 U.S.C. § 103(a)</u>

38. The following is a quotation of 35 U.S.C. § 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

39. Claims 11, 14, 25, and 27-29 are rejected under 35 U.S.C. § 103(a) as being unpatentable over [ChangSmith95], in view of [SmithChang94].

40. *The following is in regard to Claims 11, 14, 25, and 27-29.* The rejections of Claims 11, 14, 25, and 27-29 set forth in the previous Office Action are incorporated, herein, by reference. For the sake of brevity, the details of these rejections are omitted. Please refer to the appropriate sections of the previous Office Action, as well as the discussion of [SmithChang94] above.

41. Claim 13 is rejected under 35 U.S.C. § 103(a) as being as being unpatentable over [ChangSmith95], in view of [Folkers00].

42. *The following is in regard to Claim 13.* The rejection of Claim 13 set forth in the previous Office Action is incorporated, herein, by reference. For the sake of brevity, the details of this rejections are omitted. Please refer to the appropriate sections of the previous Office Action, as well as the discussion of [Folkers00] above.

43. Claims 15-16 are rejected under 35 U.S.C. § 103(a) as being unpatentable over [ChangSmith95], in view of [Smith97].

44. *The following is in regard to Claims 15-16.* The rejections of Claims 15-16 set forth in the previous Office Action are incorporated, herein, by reference. For the sake of brevity, the details of these rejections are omitted. Please refer to the appropriate sections of the previous Office Action, as well as the discussion of [Smith97] above.

Allowable Subject Matter

Objections, Allowable Subject Matter

45. Claims 4, 8, 26, and 31are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Citation of Relevant Prior Art

46. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

[SmithChTexture94] J.R. Smith and S. Chang, *Transform Features for Texture Classification and Discrimination in Large Image Databases.* IEEE ICIP-94, 1994.

[VanDeWouwer97] G. Van de Wouwer, *Color Texture Classification by Wavelet Energy Correlation Signatures.* ICIAP (1): 327-334, 1997.

[ChangKuo93] T. Chang and J. Kuo, *Texture Analysis and Classification with Tree-Structured Wavelet Transform.* IEEE Transactions on Image Processing, Vol. 2, No. 4, October 1993.

[LiangKuo99] K. Liang and J. Kuo, *WaveGuide: A Joint Wavelet-Based Image Representation and Description System.* IEEE Transactions on Image Processing, Vol. 8, No. 11, November 1999.

47. The following are particularly relevant CBIR systems:

[Moghaddam99] B. Moghaddam et al., *Defining Image Content with Multiple Regions-of-Interest,* IEEE Workshop on Content-Based Access of Image and Video Libraries, June 1999.

[Yamamoto99] H. Yamamoto et al., *Content-Based Similarity Retrieval of Images Based on Spatial Color Distributions*, IEEE Proceedings of the International Conference on Image Analysis and Processing, September 1999.

[Dupplaw99] D. Dupplaw et al., *Spatial Colour Matching for Content Based Image Retrieval and Navigation*, Challenge of Image Retrieval, 1999.

[Malki99] J. Malki et al., *Region Queries without Segmentation for Image Retrieval by Content*, International Conference on Visual Information Systems (VISUAL'99), Lecture Notes in Computer Science vol. 1614, pp. 115-122., June 1999.

[Yihong94] G. Yihong et al., *An Image Database System with Fast Image Indexing Capability Based on Color Histograms*, TENCON'94, August 1994.

[Celentano98] A. Celentano and E. Di Sciascio, *Feature Integration and Relevance Feedback Analysis in Image Similarity Evaluation*, Journal of Electronic Imaging 7(2), pp. 308-317, April 1998.

48. The following relate to subgraph isomorphism and its application to CBIR and scene analysis:

[Folkers00] A. Folkers et al., *Processing Pictorial Queries with Multiple Instances using Isomorphic Subgraphs*, Proceedings of the 15th International Conference on Pattern Recognition, Vol. 4, No. 3-7, September 2000.

[Ullmann] J.R. Ullmann, *An Algorithm for Subgraph Isomorphism*, JACM Vol. 23 , Issue 1, January 1976.

49. [Lee94] discloses a multi-resolution video indexing method which matches video frames by analyzing a multi-resolution decomposition of the video frames and hierarchically comparing local histograms at different resolutions. [Lee94] also discloses various metrics for evaluating the similarity of histograms.

[Lee94] J. Lee and B. Dickinson, *Multiresolution Video Indexing For Subband Coded Video Databases*, Proceedings of IS&T/SPIE, Conference on Storage and Retrieval for Image

and Video Databases, 1994.

50. [Huang97] applies the concept of correllograms to CBIR. A Correllogram is a single feature embedding both spatial correlation and color information.

[Huang97] J. Huang et al., *Image Indexing Using Color Correlograms*, Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition, 1997.

51. Other relevant literature by S. Chang and J.R. Smith related to the VisualSEEk system.

[SmithChTools96] J.R. Smith and S. Chang, *Tools and Techniques for Color Image Retrieval*, IS&T/SPIE Proceedings Vol. 2670, Storage & Retrieval for Image and Video Databases IV, 1996.

[SmithChLocal96] J.R. Smith and S. Chang, *Local Color and Texture Extraction and Spatial Query*, Proceedings of the International Conference on Image Processing, 1996.

[SmithChVisual96] J.R. Smith and S. Chang, *VisualSEEk: A Fully Automated Content-Based Image Query System*, ACM Multimedia '96, 1996.

52. Other commercial and academic CBIR systems:

[Virage96] J.R. Bach et al., *The Virage Image Search Engine: An Open Framework for Image Management*, SPIE Vol. 2670, March 1996.

[QBIC95] Flickner et al., *Query by Image and Video Content: The QBIC System*, IEEE Computer Magazine, September 1995.

[SurfImage98] C. Nastar et al., *SurfImage: A Flexible Content-Based Image Retrieval System*. ACM Multimedia '98, 1998.

[ImageRover97] S. Sclaroff et al., *ImageRover: A Content-Based Image Browser for the World-Wide Web*, Proceedings of the IEEE Workshop on Content-Based Access of

Image and Video Libraries, June 1997.

53. Other CBIR literature related to the evaluation and comparison of global and local image features, spatial distributions of image features, etc.

[Milanese96] R. Milanese et al., *Correspondence Analysis and Hierarchical Indexing for Content-Based Image Retrieval*, Proceedings of the International Conference on Image Processing, 1996.

[Manmatha98] R. Manmatha et al., *On Computing Local and Global Similarity in Images*, Technical Report MM-25, Center for Intelligent Information Retrieval, Computer Science Dept., University of Massachusetts, Amherst, Massachusetts, 1998.

[Jain96] A. Jain et al., *Image Retrieval Using Color and Shape*, Pattern Recognition 29 (8), pp. 1233-1244, 1996.

[DelBimbo98] A, Del Bimbo et al., *Using Weighted Spatial Relationships in Retrieval by Visual Contents*, Proceedings of the IEEE Workshop on Content - Based Access of Image and Video Libraries, 1998.

54. A fairly comprehensive survey of CBIR systems circa 2002.

[Veltkamp02] R. Veltkamp et al., *Content-Based Image Retrieval Systems: A Survey*, October 2002.

Conclusion

55. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

56. A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final

action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kevin Siangchin whose telephone number is (703)305-7569. The examiner can normally be reached on 9:00am - 5:30pm, Monday - Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amelia Au can be reached on (703)308-6604. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Kevin Siangchin
Examiner
Art Unit 2623

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